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Original Article

Towards a Climate-Resilient Family Farming Model in Togo: Challenges, Innovative Approaches and the Role of Funding from GEF8 and IFAD

[1]Toyi LEN'NAH, [2]Oumar TOUAB
[1]Doctorant, Ibn Tofail University of Kenitra.
[2]Director of ENCG Kenitra, Ibn Tofail University of Kenitra.

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Abstract: *Family farming in Togo, a pillar of food security, remains highly vulnerable to the effects of climate change. This study analyses the conditions for establishing a resilient agricultural model by linking vulnerability, adaptation strategies, public policies and financing mechanisms. The methodological approach is based on a combination of qualitative and descriptive analyses, drawing on a literature review, thematic and comparative analysis, as well as the use of survey data through descriptive statistics and cross-tabulations between beneficiaries and control groups. The results show that agroecology and climate-smart agriculture are essential levers for strengthening farm resilience, despite adoption constraints linked in particular to limited access to resources and services. Agricultural policies and initiatives such as the ZAAPs help to shape this transition, whilst funding from GEF8 and IFAD plays a key role in supporting investment and adaptation. The study highlights the need for an integrated model combining agricultural innovations, coherent policies and inclusive financing for a sustainable transformation of the agricultural sector in Togo.*

Keywords: *Family Farming, Climate Resilience, Agroecology, Adaptation, Climate Finance, IFAD, GEF8.*

I. INTRODUCTION

In developing countries, and particularly in sub-Saharan Africa, family farming forms the bedrock of rural economies and a central pillar of food security (FAO, 2018). In Togo, this production model relies mainly on small-scale farms, generally under two hectares in size, characterised by low levels of mechanisation, heavy dependence on rain-fed agriculture, and limited access to productive resources, agricultural services and markets (FAO, 2018; IFAD, 2021). However, Togo's agricultural sector faces growing vulnerabilities linked to climate change. Increased rainfall variability, the frequency of droughts and floods, and progressive land degradation are leading to unstable yields and worsening food insecurity. Available empirical data indicate significant declines in productivity for the main food crops, reflecting the sector's high exposure to climate risks (IPCC, 2022 ; FAO, 2022).

This vulnerability has also a structural and socio-economical dimension, beyond of environmental factors. Barriers imposed in terms of access to land, credit, information and agricultural services continue to constrain family farms, especially those led by women, youth or persons with disabilities who play a vital role in feeding communities around the world. Such constraints limit their ability to adapt and further exacerbate rural inequalities (IFAD, 2021). Thus, in this context, the resilience of family farms has become a key issue for agricultural development. It denotes the ability of production systems to absorb disturbance, respond with disruption and be transformed sustainably under ecological and social constraints (Folke, 2016; IPCC, 2022). It expands the all productive view to an institutional, financial and territorial dimension of agricultural transformation.

Recognizing the challenges, new approaches have emerged, including agroecology and climate-smart agriculture (CSA) 5. They seek to balance productivity with environmental integrity and climate change adaptation. These process-based measures are underpinned by structural inter ventions in Togo such as the Planned Agricultural Development Zonesthe (PADZ)

(ZAAP) and how they are adapting to climate resilient models (ZAAP-RC), with the goals of increasing access of inputs, strengthening producers' capacities and structuring agricultural value chains (ProMAT, 2025).

Concurrently, agricultural and climate policies particularly National Adaptation Plans(NAPs), Nationally Determined Contributions (NDC)and sectoral strategic frameworks demonstrate political will to embed resilience into development trajectories. Nonetheless, despite the socio-economic relevance that their application entails, they are still restrained by institutional coordination barriers, inadequate financing and disconnected from local realities (World Bank, 2021). In addition, family farms are largely excluded from formal financial channels, and lack of access to finance remains a key constraint. Climate

finance mechanisms, notably those of the GEF8 and IFAD, therefore appear as potential levers for transformation, although their accessibility and effectiveness at the local level remain a matter of debate.

In this context, a central question arises: to what extent and under what conditions do technical approaches, public policies and financing mechanisms actually contribute to building a climate-resilient family farming model in Togo?

In other words, despite the existence of proven technical solutions, structured policy frameworks and growing funding mechanisms, their coordination remains insufficient to generate sustainable transformations at the level of family farms. This situation highlights a critical issue regarding the coherence, effectiveness and inclusivity of interventions, justifying the need for an integrated analysis of the determinants of agricultural resilience.

A) Scientific contribution of the study

In this context, this article contributes to the literature by proposing an **integrated approach to agricultural resilience**, linking four key dimensions: climate vulnerability, agroecological innovations, institutional frameworks and financing mechanisms. It is distinguished in particular by its analysis of the role of international funding (GEF8, IFAD) in the transformation of agricultural systems, as well as by the integration of local dynamics through a territorialised approach.

B) Research hypotheses

Based on this research question, the study is structured around the following hypotheses:

- H1: The adoption of agroecological practices and climate-smart agriculture significantly improves the resilience of family farms.
- H2: The effectiveness of agricultural and climate policies depends on their ability to integrate local specificities and strengthen institutional governance.
- H3: Access to funding mechanisms (GEF8, IFAD) is a key factor in the adoption of innovations and the building of resilience.
- H4: The resilience of farms depends on an integrated approach combining technical innovations, a coherent institutional framework and inclusive financing mechanisms.

C) Objective of the study

In this context, this article aims to analyse the conditions for establishing a climate-resilient family farming model in Togo, focusing on the interactions between vulnerabilities, adaptation strategies, public policies and financing mechanisms, in order to identify the levers for a transition towards sustainable, inclusive and resilient agricultural systems.

II. CURRENT SITUATION

The issue of family farming's resilience to climate change lies at the heart of contemporary debates on sustainable development, particularly in sub-Saharan Africa, where agricultural systems remain heavily dependent on climatic conditions. In this context, the literature emphasises that agricultural resilience cannot be understood in a one-dimensional manner, but requires a systemic approach integrating biophysical, socio-economic, institutional and financial factors (Folke, 2016; IPCC, 2022). This section is therefore structured around four complementary analytical strands, selected for their centrality in recent scientific work. Firstly, analysing the vulnerability and resilience of family farms helps to understand the determinants of agricultural systems' exposure and adaptive capacity, in relation to their structural and socio-economic characteristics (HLPE, 2019; FAO, 2018).

Secondly, agroecological approaches and climate-smart agriculture (CSA) are selected due to their growing recognition as key technical solutions for reconciling productivity, environmental sustainability and adaptation to climate change (Lipper et al., 2014; Altieri & Nicholls, 2017). Third, adapted and resilience-enhancing strategies together with (agricultural) policy studies are crucial because institutional environments and public policies influence agricultural systems transformation pathways and intervention outcome effectiveness (World Bank, 2021; UNFCCC, 2021).

Fourthly, financing mechanisms are at the nexus of key drivers (or bottlenecks) for innovation uptake and enhanced farm resilience as evidenced in the literature that access to the financial resources is an important determinant of successful innovations adoption and wider investment needed to build resilience, particularly in countries with very strong capital constraints (Climate Policy Initiative 2020; IFAD 2023). The inclusion of these four domains therefore provides an integrated view of what contributes to the resilience of family farming, including some knowledge on how vulnerabilities interact with technical innovations and institutional and financing mechanisms.

A) Vulnerability and resilience of family farms

Extensive research has demonstrated that family farms represent a vital part of food systems in Africa, but are also some of the most susceptible to climate change impacts. This vulnerability arises from structural drivers including reliance on rain-fed agriculture, weak income diversification, poor access to agricultural inputs and services, and insecure land tenure (FAO, 2018;

HLPE, 2019). Agricultural resilience in this context is defined as how production systems can absorb shock, adapt to disturbance and transform sustainability. However, it is also determined by socio-economic and institutional context (e.g., the availability of information, markets and public support schemes) in addition to biophysical conditions (IPCC 2022; IFAD 2021).

The agricultural sector is the backbone of the economy in Togo, contributing 20% of GDP and employing more than 60% of the working population. But this excessive reliance comes along with low productivity, which has serious repercussions for food security. Food insecurity continues to affect a large proportion of the population, while the country is still highly reliant on food imports; with rice accounting for most of imported food (FAO 2022). But the sector is also vulnerable, not least because of climate change, which leads to more erratic rainfall patterns, periodic drought and flooding. These hazards affect agricultural outputs substantially, lowering the yields of major food staples by an estimated rate between 30% and 51%. ProMAT (2025) therefore estimates that the agricultural sector has a vulnerability index of 0.70, thus distinguishing this sector as one with high exposure to climate risks.

These impacts vary across social groups. Women, who make up more than half of the agricultural workforce, face persistent inequalities in access to land, credit and decision-making bodies, limiting their ability to adapt. Young people, for their part, face constraints in accessing productive resources and a lack of opportunities, encouraging them to leave the agricultural sector. People with disabilities also experience forms of exclusion that exacerbate their vulnerability, despite their potential for integration into agricultural value chains.

Furthermore, climate projections indicate a worsening of risks in the medium and long term, with an intensification of extreme events and the continued degradation of natural resources. By 2050, the vulnerability of the agricultural sector is expected to reach very high levels in certain regions, particularly in northern areas, whilst yields of major crops are expected to continue to decline (IPCC, 2022).

Faced with these challenges, farms are developing adaptation strategies based on local knowledge, such as crop diversification or adjustments to agricultural calendars. However, these strategies remain insufficient in the face of intensifying climate- al shocks (ProMAT, 2025), highlighting the need for integrated structural responses combining technical innovations, public policies and appropriate financing mechanisms.

Table 1: Current vulnerability indices for the agricultural sub-sector (Source: 4th National Communication, 2022)

Region	Current vulnerability index
Savannahs	0.8
Kara	0.78
Central	0.72
Plateaux	0.6
Maritime	0.67
Countries	0.7

Table 2: Magnitude of variations in climate parameters in 2050 and 2100 for the RCP4.5 and RCP8.5 scenarios (source: MERF, 2022)

Scenario	2050		Horizon 2100	
	Change in average precipitation compared to the baseline scenario (mm)	Change in average temperature compared to the baseline scenario (°C)	Change in average precipitation compared to the baseline scenario (mm)	Change in average temperature compared to the baseline scenario (°C)
RCP 4.5	-0.16% to +0.67%	+1.15 to +1.48°C	-0.21% to +0.89%	+1.53 to +1.96°C
RCP 8.5	-0.22% to +0.93%	+1.59 to +2°C	-0.54% to +2.22%	+3.8 to +4.8°C

Table 3: Future vulnerability indices for the agricultural sub-sector (Source: 4th National Communication, 2022)

Region	Current vulnerability index
Savannahs	0.8
Kara	0.78
Central	0.72
Plateaux	0.6
Maritime	0.67
Countries	0.7

B) Agroecological approaches and climate-smart agriculture

In light of the limitations of conventional agricultural models, agroecological approaches and climate-smart agriculture (CSA) have gradually established themselves as relevant frameworks for action to strengthen the resilience of agricultural systems, particularly in African contexts characterised by high climate vulnerability (FAO, 2018; IPCC, 2022).

Agroecology is based on the application of ecological principles to agricultural production systems, prioritising crop diversification, sustainable soil management, the integration of crop and livestock farming, and the promotion of local knowledge. These practices help to improve soil fertility, reduce dependence on chemical inputs and strengthen farms' ability to adapt to climate shocks (Altieri & Nicholls, 2017; HLPE, 2019).

Climate-smart agriculture thus seeks to integrate three mutually reinforcing results: sustainable productivity growth, adaptation to climate change and the mitigation of greenhouse gas emissions. This includes efficient irrigation as well as improved seeds, agroforestry and climate information services (World Bank 2021;IFAD 2021).

Despite this potential, the implementation of these approaches in Africa remains limited. A fairly extensive literature points to the key constraints as: technologies tend to be too expensive; information is inaccessible and/or insufficient; producers typically have very low levels of technical capacity, and on top of this, the agricultural extension system is often not effective (FAO, 2018; IFAD, 2021).

In Togo, structural initiatives have been implemented to promote these approaches and strengthen the resilience of farms. Among these, the Planned Agricultural Development Zones (ZAAP) represent a major institutional innovation. These zones, generally covering a minimum area of 100 hectares, are developed and equipped with modern agricultural infrastructure to facilitate producers' access to factors of production, notably land, water, mechanisation and finance.

The ZAAP model has several strategic objectives: to improve agricultural productivity, strengthen resilience to climate and economic shocks, support the development of value chains and preserve natural resources. By promoting the sharing of infrastructure (irrigation, storage, market access) and the introduction of modern technologies, the ZAAPs contribute to improved yields, reduced post-harvest losses and increased agricultural incomes. To promote the adoption of sustainable and climate-resilient agricultural practices within the Planned Agricultural Development Zones (ZAAPs), IFAD funding has enabled the implementation of Farmers' Field Schools (FFS) as the main agricultural extension mechanism. This participatory approach, widely recognised for its effectiveness in building producers' capacity, prioritises learning based on experimentation and the exchange of knowledge (FAO, 2013).

Within this framework, an initial target of 20 CEPs was set, prioritising crops with high commercial potential in semi-wholesale markets. In total, 17 CEPs were successfully established, including 8 in lowland areas and 9 within the ZAAPs. The topics addressed were defined through a participatory and inclusive approach, taking into account the specific needs of producers, which promotes the adoption of innovations and their dissemination at the local level.

Abotchita Rice CEP in Haho Prefecture *Djemeni Rice CEP in Haho Prefecture*

Figure 1. Comparative View of Rice Cultivation Sites (CEP) in Abotchita and Djemeni, Haho Prefecture

Furthermore, this model incorporates a significant environmental dimension through the promotion of sustainable practices such as soil conservation, integrated water management and the establishment of buffer zones. It also promotes capacity building among producers and the creation of economic opportunities within agricultural value chains.

Ultimately, agroecological approaches and climate-smart agriculture, combined with institutional innovations such as ZAAPs, appear to be essential levers for the sustainable transformation of agricultural systems. Nevertheless, their large-scale dissemination remains contingent upon the removal of technical, economic and institutional constraints, as well as the strengthening of supporting policies and appropriate financing mechanisms.

Furthermore, within the framework of promoting sustainable agricultural practices, particularly regarding the promotion of orchards and agroforestry, it is important to develop a guide describing the process and methodology for establishing orchards and agroforestry models. To this end, from 16 to 19 April 2024, a technical team from the Environment Directorate drafted the

guide on the creation of orchards and the development of agroforestry. This guide was approved at national level on 5 August 2024.

The handbook is designed to give farmers, practitioners, agricultural societies and policymakers a detailed set of rules for the planning and planting as well as management of orchards, nurseries and agroforestry systems. It will concentrate on resilient activities that enhance biodiversity, productivity and sustainability of agricultural ecosystems. The guide is holistic and will provide guidance for the establishment and sustainable management of orchards, nurseries and agroforestry systems that combine technical, socio-economics and environmental aspects sound together to promote innovative agriculture practices that also build resilient systems.

C) Adaptation strategies and agricultural policies

Strategies for adapting to climate change in the agricultural sector rely on a combination of local initiatives, public policies and interventions by technical and financial partners . At the farm level, farmers are adopting various adaptive practices, including crop diversification, water and soil conservation techniques, and climate risk management, thereby helping to strengthen the resilience of production systems (FAO, 2018; IPCC, 2022).

In Togo, the Planned Agricultural Development Zones (ZAAP) represent a major institutional innovation aimed at improving access to inputs and modernising agriculture. This approach promotes adaptation to and mitigation of climate change by reducing uncontrolled deforestation, grouping producers within a controlled zone, and adopting agricultural practices that do not degrade the soil.

However, their implementation has certain limitations. The initial development of these zones can lead to environmental impacts, notably a reduction in forest cover, as well as risks linked to soil degradation, overexploitation of water resources and a decline in biodiversity, particularly in intensive monoculture systems. Added to this are economic and social constraints, such as high investment costs, the risk of land disputes and dependence on public subsidies (World Bank, 2021; HLPE, 2020).

In response to these limitations, the emergence of the climate-resilient ZAAP (ZAAP-RC) model represents a strategic shift aimed at fully integrating adaptation and sustainability challenges. This has been achieved through: raising awareness among 426 members of the 6 ZAAPs and the development of 6 sustainable development plans; 500 hectares of hydroagricultural development for the climate resilience of the ZAAPs, and advanced irrigation systems benefiting the 6 ZAAPs

These measures reinforce the initial approach by integrating appropriate infrastructure, such as efficient irrigation systems, water retention basins and sustainable natural resource management systems at the landscape level. They also encourage the adoption of agroecological practices and the use of resilient varieties, contributing to the reduction of climate risks, the improvement of soil fertility and the preservation of ecosystems (FAO, 2018; IFAD, 2021).

Furthermore, ZAAP-RCs are part of an approach to environmental and economic sustainability, promoting carbon sequestration, the reduction of greenhouse gas emissions and the development of circular economy initiatives. They also contribute to the restoration of biodiversity and the strengthening of ecosystem services, whilst supporting value creation and rural employment.

At the national level, agricultural and climate policies play a key role in shaping adaptation pathways. Strategic frameworks, such as National Adaptation Plans (NAPs) and Nationally Determined Contributions (NDCs), increasingly recognise the importance of the agricultural sector in combating the effects of climate change (UNFCCC, 2021).

However, the literature highlights persistent challenges in the implementation of these policies, notably a lack of institutional coordination, insufficient financial resources and insufficient consideration of local specificities. Furthermore, the effectiveness of policies depends heavily on their ability to integrate the needs of smallholders and to promote their participation in decision-making processes (IFAD, 2021; World Bank, 2021).

Ultimately, agricultural adaptation strategies in Togo are based on a multi-level approach combining technical innovations, institutional frameworks and public policies. Nevertheless, their effectiveness remains dependent on better coordination between these different levels, as well as on the strengthening of local capacities and inclusive governance mechanisms.

D) The role of financing in agricultural resilience

Financing appears to be a key lever in the transition towards resilient agricultural systems. Indeed, the adoption of agroecological practices and appropriate technologies requires initial investments that are often beyond the reach of family farms. In this context, access to credit, grants and climate finance mechanisms is a determining factor in producers' adaptive capacity.

Climate finance mechanisms, such as those implemented by the Global Environment Facility (GEF) or the International Fund for Agricultural Development (IFAD), are serving to support adaptation projects and strengthen resilience of rural

communities according to recent research. More specifically, this financing instills sustainability, builds rural infrastructure and augments institutional capacity.

Drawbacks of family farming are described in the literature but so is a big funding gap (ProMAT, 2025). Expenses for smallholders: With insufficient security, high perceived risk and lack of financial inclusion; Smallholders have difficulty accessing any sort of financial instrument. Therefore, innovative financing mechanisms that address the needs of family farms should be designed.

III. METHODOLOGY

This section presents the methodological approach adopted to analyse the conditions for establishing a climate-resilient family farming model in Togo. It outlines the analytical framework, research strategy, data sources, analytical methods and the limitations of the study.

A) Analytical framework and research approach

This is an interdisciplinary study, lying at the interface of development economics, public policy analysis and agricultural sciences. The framework it uses rests on the idea of socio-ecological system resilience, where farms are seen as interconnected entities that can both endure, adapt to and transform in response to shocks, particularly climate shocks (Folke, 2016; IPCC, 2022).

The analytical framework is based on the articulation of four complementary dimensions of resilience:

- The first concerns the climate vulnerability of family farms, in relation to their exposure to and sensitivity to climate hazards.
- The second focuses on technical adaptation approaches, in particular agroecological practices and climate-smart agriculture solutions, which constitute operational responses to environmental risks (FAO, 2018).
- The third-dimension analyses agricultural and climate policies, as institutional frameworks shaping public interventions and investment priorities (World Bank, 2021).
- Finally, the fourth dimension focuses on financing mechanisms, notably those supported by the Global Environment Facility (GEF8) and the International Fund for Agricultural Development (IFAD), as essential levers for supporting resilience (IFAD, 2021).

Methodologically, the study is qualitative, analytical and explanatory regarding understanding the interconnections between these three elements of a framework provided by a multi-agent approach with the triadic interaction and perception context. This way of tackling also help us to understand dynamics underlying socio-economic and institutional aspects, while identifying levers for action that can guide towards sustainable and inclusive agricultural development.

B) Study area and unit of analysis

The study focuses on Togo, a West African country characterised by a heavy reliance on family farming, which constitutes the main source of livelihood for rural populations. The Togolese agricultural system is dominated by smallholdings, generally under two hectares in size, which are heavily dependent on climatic conditions and face persistent structural constraints, notably limited access to inputs, finance and markets (FAO, 2018; IFAD, 2021).

The unit of analysis selected is the family farm, understood as an integrated entity combining economic, social and environmental dimensions. This methodological choice allows for the analysis of adaptation strategies at the micro-level whilst taking into account interactions with institutional and macroeconomic dynamics (HLPE, 2016). The scope of the study covers the entire national territory through an approach structured around five cross-border commercial centres located between Togo and Benin, namely Gando, Kétao,

Kaboli, Anié and Notsé. The analysis includes localities situated within a 50 km radius of these centres, enabling the capture of economic and agricultural dynamics linked to cross-border trade. In total, the study covered 34 villages spread across 20 districts and 15 municipalities, spanning five main areas organised into geographical corridors: (i) the northern corridor (Savanes–Gando region and Kara–Kétao region), (ii) the central corridor (Central region – Kaboli), (iii) the south-central corridor (Plateaux region – Anié) and (iv) the southern corridor (Plateaux region – Notsé). This spatial structure allows for the country's agro-ecological and socio-economic diversity to be taken into account.

Furthermore, the study covers a total of eight prefectures (Avé, Haho, Anié, East Mono, Tchamba, Kozah, Binah and South Oti), including both beneficiaries and control groups. The survey' e base is drawn from data from the fifth General Population and Housing Census (RGPH5), ensuring the statistical representativeness of the sample and the robustness of the results.

Table 4: Study area

Region	Corridor	Prefecture	Canton	
			Beneficiaries	Witnesses
Maritime (SGL)[1]		Avé	Badja	Noepe, Akepe
Plateaux	SouthernCorridor South-central corridor	Haho Anié East Mono	Notse, Asrama, Atchave, Kpedome, Wahala Adogbenou Kamina	Hahomegbe, Akpakpakpe, Ayito Glitto, Atchinedji Moretan, Badin
Central	Central Corridor	Tchamba	Koussountou, Kaboli	Goubi, Balanka, Bago
Kara	Northern Corridor	Kozah Binah	Pya, Landa, Djamde Kpinzinde, Awandjelo, Pagouda, Lama-dessi, Kemerida	Lama, Lassa, Soumdina, Tchare, Bohou, Yade, Tchitchao, Sarakawa, Atchangbade, Koumea Pitikita, Pessare, Boufale, Solla, Ketao, Sirka
Savannahs		Ôti-Sud	Mogou, Djemegni	Dalia, Gando, Sagbiebou, Tchamonga

C) Data sources

This study is based on a mixed-methods approach combining secondary and primary data, thereby enhancing the robustness and validity of the analyses through triangulation of sources (Creswell, 2014). The secondary data used comes from three main categories of documents. Firstly, scientific literature from international journals has helped to situate the work within the field of research on agricultural resilience, agroecology, climate-smart agriculture and adaptation strategies in sub-Saharan Africa (Altieri & Nicholls, 2017; HLPE, 2019). Secondly, institutional reports produced by international and regional organisations, notably IFAD, the GEF, the FAO, the World Bank and ECOWAS, were used to analyse agricultural policies, financing mechanisms and resilience programmes (FAO, 2018; IFAD, 2021; World Bank, 2021). Finally, national documents, including Togo's agricultural and climate strategies such as national adaptation plans, sectoral policies and government roadmaps helped to contextualise the analysis at the national level.

In addition, primary data was collected over a one-month period through the distribution of questionnaires to potential beneficiaries and control groups. The data collection process involved field staff (10 CTGEA agents and 30 young and women producers from the ZAAPs), supervised by five supervisors from the regional directorates responsible for agriculture (monitoring and evaluation officers and heads of agricultural development and mechanisation departments), under the coordination of the Directorate of Policies, Planning and Monitoring and Evaluation.

This survey enabled the collection of detailed information on several key dimensions, notably farm productivity, access to upstream and downstream services in value chains, access to financial services and markets, volumes of marketed production, as well as trade constraints, including non-tariff barriers. In addition, specific data was collected on the adoption of sustainable and climate-resilient agricultural practices, as well as on indicators relating to food and nutrition security (FNS) and women's empowerment.

The data collected was transmitted daily to a centralised database within the Ministry of Agriculture, ensuring real-time monitoring. In addition, a monitoring mission was deployed to ensure data quality control and the harmonisation of data collection practices across all study areas.

D) Methods of analysis

Data analysis is based on a qualitative approach with an analytical and explanatory focus, combining several complementary techniques to ensure the robustness and consistency of the results (Creswell, 2014).

a. Literature review

A systematic review of the scientific literature and institutional documents was conducted to identify the main concepts, analytical frameworks and empirical findings relating to agricultural resilience. This stage enabled the identification of major trends and the structuring of the lines of analysis (HLPE, 2019; FAO, 2018).

b. Thematic analysis

The data were organised using an analytical framework based on the four dimensions of the analytical framework (vulnerability, adaptation approaches, public policies and financing mechanisms). This approach enabled the identification of convergences, divergences and gaps in the literature and empirical data (Braun & Clarke, 2006).

c. Comparative analysis

A comparative analysis of international and regional experiences was carried out to identify good practices that could be adapted to the Togolese context. This approach helps to situate national dynamics within a broader perspective and to enrich the recommendations (World Bank, 2021; IFAD, 2021).

d. Analysis of financing mechanisms

Particular attention was paid to the analysis of climate and agricultural financing mechanisms, notably those of the Global Environment Facility (GEF8) and the International Fund for Agricultural Development (IFAD). The analysis focused on the types of instruments mobilised (grants, concessional loans, blended finance), their areas of intervention (agroecology, adaptation, rural infrastructure) and the terms of access for beneficiaries (GEF, 2022; IFAD, 2023).

e. Statistical analysis

In addition to the qualitative analysis, the primary data from the field survey underwent descriptive statistical analysis to characterise the farms and examine the dynamics of adoption of resilient practices. Initially, descriptive statistics (means, frequencies, proportions and standard deviations) were used to analyse the socio-economic characteristics of the farms, including farm size, access to inputs, financial services and markets, as well as the level of adoption of sustainable and resilient agricultural practices. This stage enabled the development of a typological profile of family farms (Gujarati & Porter, 2009).

In a second stage, cross-analyses were carried out to explore the relationships between key variables, notably between access to finance, the adoption of agroecological and climate-smart farming practices, and agricultural performance indicators. These analyses identified significant trends and correlations, without, however, establishing strict causal relationships. Furthermore, a comparative analysis between beneficiary groups and control groups was carried out to assess differences in terms of access to resources, adoption of innovations and economic outcomes. This approach contributes to a better understanding of the potential effects of support schemes and financing mechanisms on farm resilience.

Finally, data processing was carried out using standard statistical tools, ensuring the reliability of the results and the consistency of the analyses. However, due to the exploratory nature of the study, the statistical analysis remains primarily descriptive and does not aim to establish advanced econometric relationships.

E) Development of the analytical model

Based on the results obtained, a conceptual model of climate-resilient family farming was developed. This model highlights the dynamic interactions between four key components: (i) vulnerability factors (climatic, environmental and structural), (ii) adaptation levers (agroecology, technological innovations, diversification of activities), (iii) the institutional environment (public policies and governance mechanisms) and (iv) financing mechanisms (GEF8, IFAD and other instruments).

IV. PRESENTATION AND ANALYSIS OF RESULTS

This section presents the main findings from the literature and thematic review, highlighting the interactions between the vulnerability of family farms, adaptation approaches, agricultural policies and the role of financing mechanisms. The analysis is structured around four main themes.

A) High vulnerability of family farms to climate hazards

The results show how highly susceptible family farms in Togo are to climate change. This vulnerability is primarily driven by reliance on rain-fed agriculture, the capacity for irrigation limited and the gradual degradation of natural resources especially soils (FAO, 2018;World Bank, 2021). Any changes in rainfall variability and drought episodes translate into instability in agricultural yields that affects the income and food security of rural households. Besides these climate-related factors, structural (long-standing) constraints such as limited access to agricultural inputs, extension services and markets will continue to underpin the fragility of production systems (IFAD, 2021; HLPE, 2020).

The analysis also demonstrates that this vulnerability is multidimensional. In addition to climatic factors, it is driven largely by social and economic determinants. As a result, it increases inequalities within rural communities as low-resourced farms or those with restricted access to information appear less resilient and more challenged by risks (IPCC, 2022)

This situation is closely linked to Togo's agro-climatic characteristics. The country has a tropical climate marked by two distinct regimes on either side of the 8th parallel. In the south, the sub-equatorial regime is characterised by two rainy seasons, with annual rainfall ranging from 850 to 1,800 mm. In the north, the Sudanese climate is characterised by a single rainy season, with rainfall varying between 850 and 1,350 mm. The average annual temperature is around 27°C, with variations depending on the ecological zone (National Meteorological Directorate, 2022).

In addition, its agro–ecological diversity is divided into five major regions (Savannahs, Kara, Central, Plateaus and Maritime) that translate heterogeneous production conditions. That implies different layers of vulnerability, and requires responses tailored to local specificities. The more arid northern regions are most at risk from the impacts of climate change, whereas the wet southern regions are under severe human pressure leading to ecosystem degradation.

In the end, the results confirm that vulnerability of family farms in Togo is a consequence of interaction between climatic indicators and structural constraints historical-socio-economic inequalities. Such integrated approaches integrating climate adaptation, productive capacity strengthening and access to agricultural resources and services need to be put in place.

The country's vulnerability to climate change: Togo, ranked as the 61st most vulnerable country (out of 187) according to the ND Gain index , is recognised as being particularly exposed to climate change. Analysis of meteorological data reveals a general trend towards global warming, accompanied by very high spatial and temporal variability in rainfall. An increase in the average annual temperature of 1.1°C between 1960 and 2020 was observed, representing an average rate of 0.24°C per decade[3] . Table 1 shows the change in average temperatures by region between the periods 1961–1985 and 1986–2018, marked by an increase in all regions, with a faster rate in the northern regions compared to the southern ones (Climate Knowledge Portal, World Bank, 2021).

B) Agroecological and climate-smart approaches that promote resilience

The results of the study show, against a backdrop of multiple structural and climatic constraints to production that family farms are in many cases at the forefront of practices related to agroecological approaches and climate-smart agriculture (CSA) which can contribute to building up their resilience. While these are different approaches, they act as complementary strategies to both increase productivity and minimize the use of natural resources while improving resilience to climate shocks (FAO, 2018; IPCC, 2022).

Agroecological practices, such as crop diversification, agroforestry, the use of organic fertilisers (compost, manure) and water and soil conservation techniques, contribute significantly to improving soil fertility and reducing dependence on external inputs. They also help to stabilise agricultural yields by reducing vulnerability to climate-related hazards (HLPE, 2019; Altieri and Nicholls, 2017). At the same time, climate-smart agriculture practices including the use of improved seeds, efficient irrigation systems and climate information services offer increased opportunities for adaptation and the sustainable intensification of agricultural production (World Bank, 2021; IFAD, 2021). These innovations help to improve risk management and strengthen the economic resilience of farms.

In Togo, these approaches are expressed in the implementation of several agro ecological practices (agroforestry, integrated soil fertility management, biopesticides and sustainable technologies including demo plots composters and irrigation kits. They are based on public policies and partnerships with national and international actors, such as the setting up of the National Network of Agroecology Stakeholders in Togo (RéNAAT) which aims to support and disseminate agroecological approaches at the national level.

However, despite their proven potential, the adoption of these practices remains uneven and limited. Findings show that their uptake is hampered by technical constraints (limited access to technologies), economic constraints (cost of innovations) and institutional constraints (insufficient extension and training services) (FAO, 2018; IFAD, 2021). Furthermore, the variability of agroecological conditions means that practices must be adapted to local contexts, which requires a territorialised and participatory approach.

Furthermore, a variety of agroecological practices have been identified and can be grouped into three main categories: (i) water and soil conservation techniques (stone walls, mulching, cover crops, integrated fertility management), (ii) agroforestry practices (assisted natural regeneration, hedgerows, agroforestry systems) and (iii) practices to improve soil fertility and structure (crop rotation and intercropping, use of organic matter, agro-pastoralism). Although promising, these practices are still not sufficiently widespread on a large scale.

Ultimately, the results confirm that agroecology and climate-smart agriculture are key drivers for a transition towards more resilient and sustainable agricultural systems. However, their impact depends heavily on capacity building for producers, improved support mechanisms and the integration of these approaches into coherent and inclusive public policies.

Table 5: Developed and potential practices by zone and region.

Agroecological zone/Region	Practices and techniques
Dry savannah/Savannahs	○ Assisted natural regeneration (ANR) and fallow management ○ Compost production and use o Contour ploughing ○ GIFS, GIFERC ○ Stone ridges, mulching, grass strips, o Small embankments, half-moon, o Use of approved products ○ Crop rotation (cereals and vegetables) o Practising improved fallow o Integration of agro-pastoralism

Dry savannah/Kara		○ Use of pesticides o Production and use of compost o Vegetable nurseries on tables o Reforestation of river catchment areas o Use of registered products o Use of bio-pesticides ○ Crop rotation (cereals and vegetables) o GIFS, GIFERC o Terrace farming o Improved fallow ○ Integration of agro-pastoralism into agriculture
Humid/Central savannah		○ Vegetation fire management o Use of plant protection products o Application of high-quality base fertiliser o Reforestation / agroforestry ○ Use of registered products and FSRapproved use of bio-pesticides ○ Crop rotation (cereals and vegetables) o Practising improved fallow ○ GIFS, GIFERC ○ Integration of agro-pastoralism into agriculture
Agroecological zone/Region		**Practices and techniques**
Wet savannah / Eastern Plateaus		○ Agroforestry ○ Management of pesticide waste and packaging in cotton-growing areas ○ Composting in cotton-growing areas ○ Use of registered products and use of biopesticides ○ Crop rotation (cereals and vegetables) o Practising improved fallow ○ GIFS, GIFERC ○ Integration of agro-pastoralism into agriculture
Forestry / Plateaus	Western	○ Restoration of ground cover beneath coffee and cocoa plantations ○ Agroforestry o Prudent use of plant protection products o Good practices in the use of registered products and the use of biopesticides o GIFS, GIFERC ○ Crop rotation (cereals and vegetables) o Practising improved fallow ○ Integration of agro-pastoralism into agriculture
Coastal region	Maritime	○ Agroforestry ○ Compost production and use ○ Good fishing practices (small-scale fishing) ○ Good practices in the use of approved products and the use of biopesticides o GIFERC, GIFS ○ Crop rotation (cereals and vegetables) o Practising improved fallow ○ Integration of agro-pastoralism into agriculture

Source: *National Strategy for the Development of Agroecology and Organic Farming 2021– 2030*

When it comes to organic farming, Togo is a major player in West Africa for the export of organic products, particularly soya, to the European Union. Indeed, in response to the growth of organic farming and Togo's desire to play a leading role in this sector, the country has adopted a national strategy for the development of agroecology and organic farming by 2030. To structure the sector, the country has developed its own certification scheme, BioSPG (BioSystème de Production Participatif), which aims to guarantee product quality and support smallscale producers.

In terms of the volume of organic exports to the EU, Togo has achieved significant results. It is important that this momentum is maintained and strengthened through approaches that support and facilitate access to the external organic market (negotiated trade contracts). However, the development of the local organic market must not be overlooked; to this end, isolated initiatives will help raise the profile of organic products.

C) Evolving agricultural policies, but still limited in their operational implementation

A review of agricultural and climate policies in Togo underscores an evolution towards increasing incorporation of resilience, sustainability and climate adaptation themes within national frameworks. These are consistent with regional and international frameworks, particularly the Malabo Declaration, as well as aspects of the Sustainable Development Goals (SDGs), including the ongoing application of the National Programme for Agricultural Investment and Food and Nutritional Security (PNIASAN).

These results highlight the disconnect between strategy aspirations and actual execution. Interventions are limited by institutional constraints, such as a lack of coordination between public and private actors and technical and financial partners (World Bank, 2021). Moreover, the lack of access to agricultural services, information and support mechanisms by family farms limits the inclusive impact of the policies put in place (IFAD, 2021).

In terms of finance, both public and private commitments remain short of targets. However, while the PNIASAN provides for more than 1,200 billion CFA francs in total investment, less than or around 42% of the resources have been mobilised, showing

a structural funding gap. In addition, the proportion of the national budget that goes to agriculture is below the Maputo commitment (10%): between 2017 and 2022, it stood at an average of 5.17 percent (AfDB, 2022).

The model of agropoles and Planned Agricultural Development Zones (ZAAPs) is an innovation of an institutional nature for the agricultural development of Cameroon, which has served to modernise the sector and structure agricultural value chains. The results obtained, especially with regard to increased cultivated areas and infrastructure development, are signs of tangible progress. Bottom line: This progress is variable by sector, and some crops are showing good performance, while others remain vulnerable, largely due to soil degradation/poor economic incentives.

This includes the key lessons provided from various implemented agricultural policies, like the setting up of the institutions responsible for agri-financing and processing. While these efforts bolster sectoral governance, they too are conditional on their capacity to better orchestrate and implement actions (FAO, 2018). Furthermore, the findings highlight persistent structural challenges, notably limited access to improved technologies, poor water management, land constraints, low levels of mechanisation and inadequate rural infrastructure. These constraints are exacerbated by the effects of climate change, which significantly affect agricultural yields. Recent data indicate significant declines in productivity for several strategic crops, confirming the sector's vulnerability to climate shocks (IPCC, 2022).

Despite the progress made, agricultural policies still struggle to fully integrate local specificities and indigenous knowledge, which limits their uptake by producers and reduces their effectiveness on the ground (HLPE, 2020). Ultimately, the findings confirm that, although Togolese agricultural policies are moving towards greater consideration of resilience issues, their impact remains limited by institutional, financial and structural constraints. A more integrated approach, based on enhanced coordination among stakeholders, increased funding and better adaptation to local realities, appears essential to ensure a sustainable and inclusive transformation of the agricultural sector.

D) Institutional framework and financing mechanisms: towards greater financial inclusion and resilience of family farms

The findings highlight that financing mechanisms, particularly those supported by the Global Environment Facility (GEF8) and the International Fund for Agricultural Development (IFAD), are key levers for strengthening the resilience of family farms. By facilitating access to financial resources, these mechanisms contribute to the adoption of sustainable and climate-smart agricultural practices, the development of rural infrastructure and the capacity building of agricultural stakeholders (IFAD, 2021; FAO, 2018).

However, the effectiveness of this financing depends heavily on the institutional framework and the accompanying governance mechanisms. In this regard, coordination mechanisms between public actors, technical and financial partners, and the private sector play a decisive role in optimising resource allocation and enhancing their impact (World Bank, 2021).

In this context, strengthening partnerships with financial institutions, particularly microfinance institutions (MFIs) and banks, appears to be an essential condition for improving access to agricultural credit, particularly for vulnerable groups such as women, young people and people with disabilities. The introduction of risk-sharing mechanisms, such as guarantee funds and cofinancing schemes, helps to reduce barriers to accessing finance by mitigating the risk perceived by financial institutions (Beck et al., 2013).

The results also show that the financial innovations implemented – in particular tripartite mechanisms combining grants, beneficiary contributions and bank loans – promote productive investment and the development of agricultural micro, small and medium-sized enterprises (MSMEs). These schemes help to modernise production systems, improve the processing and marketing of agricultural products, and strengthen the integration of family farms into value chains (OECD, 2020).

Furthermore, the introduction of specific mechanisms such as input credits and working capital provides an appropriate response to the seasonal constraints of agricultural production. These schemes facilitate access to essential inputs whilst fostering the establishment of sustainable relationships between producers, suppliers and financial institutions, thereby contributing to the gradual financial inclusion of agricultural holdings (World Bank, 2020).

However, despite these advances, several constraints remain. Access to finance remains limited for a large proportion of smallholders, due in particular to collateral requirements, high interest rates and the unsuitability of financial products to the specific characteristics of the agricultural sector (IFAD, 2021). Furthermore, the capacity of financial institutions to assess agricultural risks remains insufficient, which limits the expansion of rural credit.

In this context, capacity building for financial institutions and support actors appears to be a strategic lever for improving the quality and accessibility of financial services. Training programmes in climate-smart agriculture (CSA), as well as the development of tailored agricultural advisory services, help to improve the dissemination of innovations and strengthen the resilience of production systems (HLPE, 2020; FAO, 2018).

Ultimately, the findings confirm that the impact of financing mechanisms on the resilience of family farms depends on their integration into a coherent, inclusive and functional institutional ecosystem. Better coordination between international financing, national public policies and local mechanisms is therefore essential to promote sustainable, resilient and inclusive family farming.

E) Towards an integrated model of resilient family farming

Analysis of the results highlights the need to adopt a systemic approach to sustainably strengthen the resilience of family farming in Togo. This approach is based on the coordination of four complementary levers: technical, institutional, economic and financial.

From a technical perspective, the dissemination of agroecological practices and climate-smart innovations appears to be a key factor in adapting to climate hazards (FAO, 2018; World Bank, 2021). However, the results show that access to inputs, whilst necessary, remains insufficient to guarantee sustainable resilience, particularly for vulnerable groups such as women, young people and people with disabilities. In this context, strengthening organisational, technical and managerial capacities is an essential lever for the empowerment and professionalisation of farms (IFAD, 2021).

At the institutional level, the effectiveness of interventions depends on the quality of governance and the structure of producer organisations. The findings highlight the importance of enhanced institutional support, particularly through agricultural extension and agencies, professional organisations and multi-stakeholder partnerships. A participatory approach to the planning and sustainable management of natural resources, as well as securing access to land, appears to be a key condition for encouraging long-term investment in sustainable land management (HLPE, 2020).

Economically, the integration of family farms into agricultural value chains is a key factor in resilience. The development of rural micro, small and medium-sized enterprises (MSMEs), particularly through agricultural entrepreneurship, promotes income diversification and strengthens the economic viability of farms (OECD, 2020). The findings also show that support for processing, marketing and the structuring of value chains helps to improve market access and increase agricultural value added.

Finally, from a financial perspective, the mobilisation of appropriate funding, particularly through climate funds and international financing mechanisms, appears to be a key driver for transforming the agricultural sector. However, the effectiveness of such funding depends on its accessibility and its alignment with local needs. Strengthening the capacity of local actors to mobilise climate finance and design appropriate projects is therefore a major challenge for the large-scale dissemination of resilient agricultural practices (Green Climate Fund, 2022; IFAD, 2021).

In this context, the model of Climate-Resilient Planned Agricultural Development Zones (ZAAP-RC) appears to be a relevant institutional innovation. By promoting the pooling of resources, the collective organisation of producers and the dissemination of best practices, this model helps to strengthen local capacities and facilitate the replication of initiatives at the national level. The establishment of learning networks and exchange platforms between agricultural zones also constitutes an effective mechanism for disseminating innovations (Rogers, 2014).

Ultimately, the results confirm that the resilience of family farming cannot be achieved through isolated sectoral interventions but requires structural transformation based on an integrated, multi-stakeholder approach. The coordination of public policies, international funding (notably GEF8 and IFAD) and local dynamics thus appears to be an essential condition for ensuring sustainable, inclusive and resilient agricultural development.

V. DISCUSSION AND RECOMMENDATIONS

The findings of this study provide an analytical contribution to understanding the determinants of family farm resilience in Togo, highlighting the structuring role of the interplay between technical innovations, institutional frameworks and financing mechanisms. Contrary to a traditional sectoral approach, the results confirm that agricultural resilience is based on systemic dynamics, thereby validating the hypothesis of complementarity between these different levers (H4).

From an empirical perspective, the results show that the adoption of agroecological practices and climate-smart agriculture improves farms' adaptive capacity (H1), but this adoption remains heavily constrained by resource-access constraints. This finding highlights a significant limitation of current approaches: the effectiveness of technical innovations depends less on their agronomic relevance than on their economic and institutional accessibility. This conclusion constitutes an important research contribution, emphasising that the transition to resilient agriculture cannot be envisaged without transforming the conditions of access to innovations.

Furthermore, the analysis reveals that agricultural and climate policies, although aligned with resilience objectives, are ineffective due to limited coordination and insufficient adaptation to local contexts (H2). This situation confirms the existence of a structural gap between strategic planning and operational implementation, a major obstacle to transforming the agricultural

sector. The study thus highlights the need to strengthen mechanisms for territorial governance and for co-construction of policies with local stakeholders.

With regard to financing mechanisms (H3), the results show that the GEF8 and IFAD schemes play a catalytic role in supporting resilience, particularly through financing infrastructure, technical innovations, and capacity building. However, their impact remains limited by accessibility constraints, particularly for the most vulnerable farms. This finding highlights a central issue in the literature on climate finance: the shift from a project-based funding approach to one of effective financial inclusion for producers.

Beyond these findings, one of the major contributions of this study lies in highlighting the need to integrate disruptive innovations into agricultural resilience strategies. Indeed, in the face of intensifying climate shocks, conventional approaches, even when improved, may prove insufficient to guarantee sustainable resilience. With this in mind, several strategic and innovative recommendations can be formulated.

Firstly, the development of soilless production systems (hydroponics, aquaponics, greenhouse cultivation) represents a promising alternative for reducing dependence on climatic hazards, particularly in areas highly exposed to rainfall variability. These systems enable optimised water use, intensified production on small areas and better control of production conditions. However, their widespread adoption requires appropriate financial and technical support, particularly in terms of initial investment and training for producers.

Secondly, the integration of digital technologies and artificial intelligence into agricultural systems appears to be a strategic lever for strengthening resilience. The use of AI-based solutions such as decision-support systems, localised weather forecasts, mobile apps for agricultural advice, and crop management tools helps improve risk management, optimise agricultural schedules, and increase the efficiency of farming practices. In the Togolese context, the development of digital agriculture could help reduce information asymmetries and improve producers' access to agricultural services.

Thirdly, the scaling up of climate-smart practices must be approached from the perspective of sustainable intensification. This involves not only disseminating existing climate-smart technologies (improved seeds, efficient irrigation, agroforestry), but also adapting them to local conditions through participatory approaches. The integration of climate services, such as early warning systems and agro-meteorological bulletins, is also a key lever for improving producers' ability to anticipate events.

Fourth, financing mechanisms need to be rethought so as to nurture these innovations. It includes the creation of financial products for innovative agricultural investments, such as medium-term loans, targeted grants for climate-smart technologies, and blended finance schemes combining public and private funds. In addition, climate-indexed agricultural insurance and guarantee funds could reduce risks and improve access to credit services.

Fifth, capacity building of stakeholders will be a critical step towards the adoption of these innovations. Includes training producers in new technologies, developing digital extension services, and promoting collective learning platforms (including farmer training fields).

Lastly, enhancing governance and coordination systems seems vital to guarantee that interventions are coherent. Multi-stakeholder frameworks involving public authorities, financial institutions, producer organisations and actors of the digital sector would foster an integrated and sustainable approach to agricultural resilience.

In conclusion, this study shows that it does not stop at upgrading existing practices when we talk about the transition to a climate-resilient family farming model in Togo does not stop at upgrading existing practices but also includes technological, organisational, and financial innovations. This transformation involves redirecting public policy and financial mechanisms toward approaches that are more inclusive, integrated, and responsive to current climate realities.

VI. CONCLUSION

The analysis of the resilience of family farms in Togo highlights the systemic and multidimensional nature of the determinants of agricultural transformation, arising from the complex interactions among climate vulnerability, agricultural practices, institutional frameworks, and financing mechanisms. In the face of intensifying climate hazards, family farming appears both as a sector highly exposed to risks and as a strategic lever for the transition towards sustainable and inclusive production systems.

The findings of this study confirm that agroecological approaches and climate-smart farming practices are essential levers for strengthening farm resilience, by contributing to improved natural resource management, yield stabilisation and livelihood diversification. However, their large-scale adoption remains dependent on structural and in al factors, notably access to productive resources, support services and financing mechanisms. This finding highlights that the effectiveness of technical innovations depends closely on their integration into a favourable institutional and economic environment.

Furthermore, the study highlights the decisive role of climate finance mechanisms, particularly those of the GEF8 and IFAD, in supporting agricultural investment, adaptation and capacity building for producers. Nevertheless, the analysis reveals a gap between the availability of funding and its actual accessibility for family farms, particularly the most vulnerable ones. This situation highlights a key challenge in transforming agricultural financing systems, which must evolve towards models that are more inclusive, flexible and adapted to local realities.

Beyond conventional approaches, this research also highlights the need to integrate emerging innovations into pathways to agricultural resilience. The development of soilless production systems, the use of digital technologies and artificial intelligence, as well as the strengthening of climate services, appear to be complementary levers capable of significantly improving the adaptive capacity of farms. These innovations, combined with agroecological approaches, offer new prospects for the sustainable and resilient intensification of agricultural production.

In this regard, one of the main contributions of this study lies in the proposal of an integrated framework for analysing agricultural resilience, coherently linking technical, institutional and financial dimensions. This approach highlights that resilience cannot be achieved through isolated interventions, but requires structural transformation based on enhanced coordination of public policies, effective financial inclusion and the adoption of innovations by local stakeholders.

Consequently, the development of a climate-resilient family farming model in Togo relies on a reconfiguration of agricultural systems centred on integration and innovation. Such a transformation requires not only increased public and private investment, but also the adaptation of governance frameworks and financing mechanisms to the specific characteristics of the agricultural sector. It is an essential condition for ensuring food security, reducing rural poverty and providing a sustainable response to climate and socio-economic challenges.

Finally, this research opens up significant avenues for future work, notably through the development of quantitative analyses to measure the impact of various resilience drivers, as well as the empirical evaluation of technological and financial innovations in African agricultural contexts.

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